Consequences of BSE on Consumers' Attitudes, Perceptions and Willingness to Pay for Certified Beef in Spain

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CONSEQUENCES OF BSE ON CONSUMERS' ATTITUDES, PERCEPTIONS AND WILLINGNESS TO PAY FOR CERTIFIED BEEF IN SPAIN

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Abstract

The BSE crisis has increased consumers' concerns on beef safety. Product quality systems and controls have been reinforced. Traceability certification and quality labels have been developed to communicate consumers the safety characteristics of the labelled beef and recover consumption. As a consequence, production costs have increased, which have been ultimately transmitted to consumer prices. The objective of this paper is to develop a conceptual model able to analyse main factors influencing consumers' willingness-to-pay for certified beef. A three-equation recursive model is jointly estimated. Results indicate that income, level of beef consumption, the average price consumers paid for beef and beef safety perception are main determinants of Spanish consumers' willingness- to-pay for certified beef.

Key words: Certified beef, willingness-to-pay, attitudes, food safety.

1. Introduction

During the last years, both the supply and the demand for food products have undertaken important changes. On the supply side, a new technological revolution is taking place, which has substantially increased the number of food products available to the final consumer. Technological processes have become increasingly complex which, on the other hand, have generated new concerns about their long-run effects on the environment and/or the human health (GMO,...). On the demand side, food markets in developed countries, especially in Europe, are facing some marketing problems mainly related to consumers' loss in confidence on the food chain. Recent food scares have increased consumers' concerns on food safety with significant reductions in the consumption of affected products. As a consequence, the food industry have designed tracing systems and increased vertical coordination to guarantee food safety along the food chain. Moreover, policy makers have reinforced controls and strengthened the role of Food Safety Agencies.

Partly due to these changes, many authors in the last years have started to analyse consumers' increasing concerns about food safety as well as to explore the potential impact of both marketing and policy strategies specially designed to mitigate their loss of confidence on food products. Some authors have designed "ad hoc" surveys to evaluate to what extent consumers took into account food safety issues when made food choices (Wessells et al, 1996; Cowan, 1998; Verbeke and Viaene, 1999, 2001; Porin and Mainsant, 1998; Henson and Northen, 2000, among others).

Food safety concerns have been particularly important in the beef sector in Europe where consumption has been reduced due to the BSE crisis (35 per cent of consumption reduction in the case of Spain). The recovery of beef consumption to past levels has been a challenge in which producers, manufacturers and policy makers have participated. Product quality systems and controls have been reinforced to guarantee that beef was safe enough. However, food safety is a credence attribute (it cannot be observed by consumers neither before nor after purchasing the product). Thus, certification strategies (traceability and/or quality labels) have been implemented both at European and national levels to communicate consumers the safety characteristics of the labelled beef.

Reinforced controls or, al least, the more strict application of the already existing regulation, have increased production costs both at the producer, wholesale and retail levels, which ultimately have been transmitted to consumers through higher prices (around 20% of price increase in Spain). In this context, the main objective of this paper is twofold. On one hand, to what extent Spanish consumers are willing to pay an overprice for labelled beef, with labels including a traceability certification. On the other, the paper aims to provide some insight about what are the main factors that could explain the consumers' decision process.

Several studies have already analysed such issue in meat or other food products (Fisher, 1995; Buzby et al., 1998; Caswell, 1998; Latouche et al, 1998; Zanetti, 1998; Sánchez et al, 2001, among others). However, no attempt has been made in the literature to consider simultaneously all steps in the consumers' decision process. In this paper, we specifically model three steps in the consumer decision: 1) attitudes towards food safety; 2) perceived safety for beef; and 3) certified beef purchasing intention. The three equations are jointly estimated by maximum likelihood, allowing for simultaneity in consumers' decisions, which is the main novelty of the paper. Among the explanatory variables, the most relevant are: psicographic and socio-economic characteristics of respondents; how they have received information about food scares; to what extent they read food labels and feel confident about the information included in them; beef consumption expertise; and finally, endogenous variables of previous equations. Data used in this study come from a nation-wide telephone survey conducted in Spring 2002.

To achieve the mentioned objectives, the paper is organised as follows. First, some descriptive data from the survey is offered. Second, the theoretical model of consumer behaviour and its econometric specification are formulated. Third, results from the estimated model are provided. Finally, some concluding remarks are outlined.

2. Consumers' concerns and attitudes towards food safety issues in Spain

As mentioned in the introduction, data have been collected from a nation-wide telephone survey conducted in Spring 2002. Only respondents over 20 years old and being responsible of the shopping within the household were selected. A total of 650 valid responses were obtained. The sample was randomly selected although a quota system was established to guarantee sample representativeness in terms of geographic and age distribution. The questionnaire was structured into four main blocks. In the first one, questions related to consumers' concerns about food safety, how information had been received and to what extent food habits had change, were included. In the second block, the questionnaire aimed to collect information about consumers' attitudes towards food safety and to measure how safe consumers perceived alternative food products (vegetables, meat, ready-to-eat meals, etc), production processes and marketing channels, including food-away-from-home outlets. The third block dealt specifically with traceabilitry and certification. After explaining consumers what traceability meant, the survey collected information about consumers' willingness to pay a premium for certified beef. Finally, some socio-economic as well as psicographic characteristics of respondents were included.

Results from the survey indicate that food scares that have taken place in Europe in the last years, specially the BSE, have substantially increase consumers' concerns about food safety in Spain. As Table 1 shows, 63% of respondents declared to be more concerned than five years ago about food safety. If only the problem *per se* is considered, this result seems somewhat surprising, at least from a rational point of view, and some other factors have to be found to explain it. The most important is, without any doubt, that mass media coverage of recent food scares. Moreover, 52% of respondents recognize that mass media exerts a high influence in their shopping and consumption habits.

To what extent increasing concerns on food safety have modified shopping behavior is shown at the bottom of Table 1. It seems that, although positively correlated, consumers' concerns have not been corroborated by changes in food habits of the same magnitude. In any case, almost half of respondents declared to have changed their shopping habits, which is a relatively high percentage. Respondents, then, were asked in which way they had changed. Around 81% of them had given up

buying the product, 40% had started to read food labels more carefully, 28.5% had moved to brands which offered them more confidence and guarantee and, finally, 4% had changed the retail outlet in which they normally made the shopping.

Table 1. Consumers concerns about food safety and behavioral changes after food scares in Spain

Consumers concerns about food safety	
Lower than five years ago	2%
The same as five years ago	35%
Higher than five years ago	63%
Influence of mass media in shopping behavior	
Yes	52%
No	47%
No answer	1%
Have you changed your food shopping behavior after the recent food scares?	
Yes	49%
How?[1]	
Not buying the product affected by the food scare	80,7%
Reading more carefully food labels	39,2%
Changing towards well known and more confident brands	28,5%
Changing the retail outlet where I do my shopping	4,1%
No	51%

[1] It was a multiple-choice question (the sum of percentages has not necessarily to be 100).

Table 2 shows consumers' general attitudes towards food safety, using a five-point scale (items are taken from Henson and Traill, 2000) (the last item is used as a general statement for construct validation purposes). As can be observed, Spanish consumers associate food safety with the existence of a clear indication of the sell-by-date. On the other hand, in general terms, they perceived that food products are not as safe as they should be and feel that they do not have enough information to assess food safety before buying it. Finally, consumers have serious doubts about food safety in processing firms, food handling in restaurants and express some concerns about the healthiness of some commonly used additives.

Table 2. Spanish consumers' attitudes towards food safety

Provided a food is within its sell-by-date it is safe to eat	3.39
I am satisfied that the additives in food today are not harmful to my health	2.63
Standards of hygiene in food processing are higher than they used to be	2.45
I trust the government to ensure that the level of pesticide residuesin food is safe	3.04
Restaurants do not care enough when handling food	2.96
Food is not as safe as it used to be	3.65
I am not provided with enough information to judge properly whether food is safe or not	3.48
In general I am satisfied with the safety of food available today	2.92

Note: the Cronbach alpha was 0,76 indicating that the construct was reliable

Results mentioned above indicate increasing consumers' concerns on food safety derived from food scares has also generated a consumers' loss of confidence towards food which seems to be more important in the products involved in the corresponding food scare. We have tried to explore deeper this point by asking respondents about their perceived safety of selected groups of products. Results are shown in Table 3. A can be observed in a five point-scale, respondents declare a higher loss of confidence in meat products, canned food, preserved food and ready-to-eat meals. Moreover, the standard deviations associated to such products are higher indicating some variability among consumers' perceptions. Finally, note that imported food is not considered very safe.

3. Theoretical and econometric model

It is widely acknowledged that consumers' decisions are the result of a complex process not always very well understood as many personal and environmental factors may contribute to final

choices. Consumers' attitudes, beliefs and behaviour are formed interdependently following some kind of causal chains. In this paper a recursive model is estimated to determine main factors explaining consumers' willingness to pay for certified beef (Figure 1). It is assumed that respondents' socio-economic characteristics and food habits and lifestyles may affect the three main dimensions of our model.

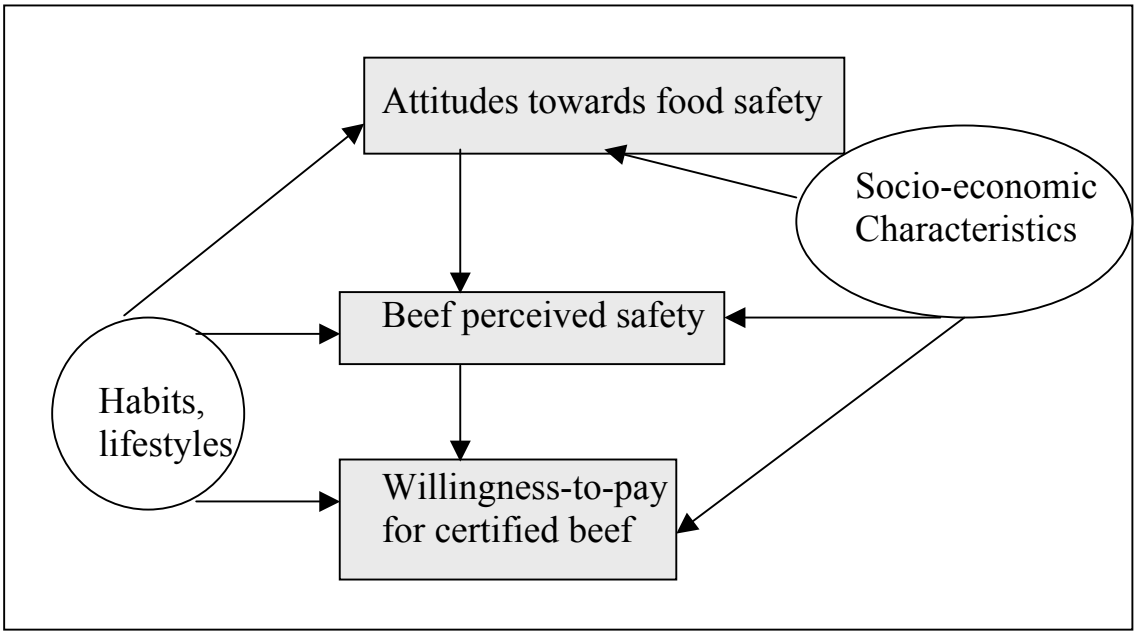
Table 3. Consumers' perceived safety of different food products

Food product	Perceived safety[a]	Food product	Perceived safety[a]
Fresh fruits	4,53 (0,62)	Ready-to-eat meals	2,58 (1,21)
Fresh vegetables	4,52 (0,73)	Preserved food	3,32 (1,23)
Beef	2,61 (1,43)	Canned Food	3,36 (1,27)
Lamb	3,45 (1,13)	Eggs / Mayonnaise	4,10 (0,87)
Pork	3,66 (1,05)	Rice	4,50 (0,70)
Chicken	4,00 (0,96)	Pasta	4,55 (0,61)
Fish	4,53 (0,70)	Wine	4,57 (0,66)
Seafood	4,45 (0,78)	Oil	4,66 (0,57)
Milk products	4,32 (0,79)	Imported food	2,61 (0,62)

[a] A five-point Likert scale has been used with 1 indicating the minimum safety value. Values in parentheses are standard deviations.

The first two dependent variables (general attitudes to food safety and perceived safety for beef) are categorical variables. In the first one, we have considered respondents' valuations, on a five-pont scale, to the general item included at the bottom of Table 2. We have carried a factor analysis with the other 7 items and the two factors obtained are highly correlated to the general statement. In the second one, an ordered five-point scale also measured their perception about beef safety with 5 indicating very safe (see table 3 for average values). In both cases, the original five-point scale was reduced to a three-point one.

Figure 1. Conceptual model to explain consumer willingness-to-pay for certified beef



Finally, the willingness-to-pay equation has been specified as a two-step decision process. First, consumers decide if they are willing to pay a premium for certified beef over the price they are actually paying. Second, if they are willing to pay, they decide how much more. Premia are expressed as percentage price increase over prices they are normally paying.

Taking these issues into account, four dependent variables have been defined: attitudes towards food safety for food (FS_i), perceived safety for beef (BS_i), whether an individual is willingness to pay for labelled beef (P_i) and finally, the increase in price over its actual paid price consumers would

pay (PP_i). These four variables are modelled as a recursive system such that BS_i is explained by FS_i; and P_i and PP_i are explained by BS_i. In what follows, vectors of explanatory variables x_i^{FS}, x_i^{BS}, x_i^{P} and x_i^{PP} are used to explain attitudes towards food safety, perceived safety for beef, willingness to pay for labelled beef and how much they are willingness to pay, respectively, with corresponding parameter vectors β^{FS}, β^{BS}, β^{P} and β^{PP} and random errors ε_i^{FS}, υ_i^{BS}, υ_i^{P} and υ_i^{PP}.

Perceived safety for food (FS_i) is a categorical variable, measuring consumers' perception for food safety. The original five-point scales has been transformed to an ordered categorical variable with three categories (low, medium and high). Consequently, this variable has been categorised by an ordered polychotomous response model:

$$FS_i^* = \beta^{FS} x_i^{FS} + \varepsilon_i^{FS} > 0 \tag{1}$$

$$FS_i^* = j \qquad if \quad \mu_{j-1}^{FS} < FS_i^* \le \mu_j^{FS}, \qquad j = 1,2,3$$

where ε_i^{FS} is distributed as $N(0,1)$, and threshold parameters μ_j^{FS} are normalized such that $\mu_0 = -\infty$, $\mu_1 = 0$ and $\mu_3 = \infty$ for identification. Finally, FS^*_i is the corresponding latent variable measuring the level of this type of attitude.

Perceived safety for beef (BS_i) is a categorical variable, measuring consumers' perception for beef safety. Also, three ordered degrees have been considered (low, medium and high) and, hence, it has also been categorised by an ordered polychotomous response model:

$$BS_i^* = \beta^{BS} x_i^{BS} + \alpha^{BS} FS_i^* + \upsilon_i^{BS} > 0 \tag{2}$$

$$BS_i^* = j \qquad if \quad \mu_{j-1}^{BS} < BS_i^* \le \mu_j^{BS}, \qquad j = 1,2,3$$

where α^{BS} is a scalar parameter, υ_i^{BS} is distributed as $N(0,1)$, and threshold parameters μ_j^{BS} are normalized such that $\mu_0 = -\infty$, $\mu_1 = 0$ and $\mu_3 = \infty$ for identification. Finally, BS^*_i is the corresponding latent variable measuring the level of this type of attitude.

Willingness to pay is modelled using a sample selection model (Heckman, 1979). The first participation component, whether a consumer is willingness to pay, is modelled as a probit based on the binary outcome $P_i \in \{0,1\}$:

$$P_i = \begin{cases} 1 & \text{if} \quad P_i^* = \beta^P x_i^P + \alpha^P BS_i^* + \upsilon_i^P > 0 \\ 0 & \text{otherwise} \end{cases} \tag{3}$$

where α^P is a scalar parameter, the random error υ_i^P is distributed as $N(0,1)$, and BS^*_i is the corresponding latent variable measuring the perceived level of beef safety. That is, if the ith individual is observed to be willingness to pay a positive amount of money for labelled beef, then $P_i = 1$.

The second component is the increase in paid price consumers are willing to pay. It is a censored variable such as:

$$PP_i = \begin{cases} PP_i^* = \beta^{PP} x_i^{PP} + \alpha^{PP} BS_i^* + \upsilon_i^{PP} > 0 \\ 0 \qquad \text{otherwise} \end{cases} \tag{4}$$

where α^{PP} is a scalar parameter and $\upsilon_i^{PP} \sim N(0, \sigma_{PP}^2)$.

To sum up, the random-error vector $\{\varepsilon_i^{FS}, \upsilon_i^{BS}, \upsilon_i^{P}, \upsilon_i^{PP}\}$ is normally distributed with zero mean vector and covariance matrix:

$$\begin{bmatrix} 1 & \sigma_{FS,BS} & 0 & 0 \\ & 1 & \sigma_{BS,P} & \sigma_{BS,PP} \\ & & 1 & \sigma_{P,PP} \\ & & & \sigma_{PP}^2 \end{bmatrix} \tag{5}$$

Note that since FS_i^* and BS_i^* in (2), (3) and (4) are unobserved, and FS_i and BS_i, respectively, are not a good proxy for it, we use $\hat{FS}_i^* = \hat{\beta}^{FS} x_i^{FS}$ and $\hat{BS}_i^* = \hat{\beta}^{BS} x_i^{BS} + \hat{\alpha}^{BS} \hat{FS}_i^*$, instead to explain consumers' perceptions for food and beef safety. Therefore, the model for explaining consumers' perception for beef safety becomes:

$$BS_i^* = \beta^{BS} x_i^{BS} + \alpha^{BS} \hat{FS}_i^* + \varepsilon_i^{BS} > 0 \tag{6}$$

$$BS_i^* = j \qquad if \quad \mu_{j-1}^{BS} < BS_i^* \le \mu_j^{BS}, \qquad j = 1,2,3$$

And the sample selection model for willingness to pay for labelled beef becomes:

$$P_i = \begin{cases} 1 & \text{if} \quad P_i^* = \beta^P x_i^P + \alpha^P \hat{BS}_i^* + \varepsilon_i^P > 0 \\ 0 & \text{otherwise} \end{cases} \tag{7}$$

$$\text{and } PP_i = \begin{cases} PP_i^* = \beta^{PP} x_i^{PP} + \alpha^{PP} \hat{BS}_i^* + \varepsilon_i^{PP} > 0 \\ 0 \qquad \text{otherwise} \end{cases} \tag{8}$$

The composite errors are given by:

$$\varepsilon_i^{BS} = \upsilon_i^{BS} + \alpha^{BS} \varepsilon_i^{FS}; \qquad \varepsilon_i^{P} = \upsilon_i^{P} + \alpha^{P} \varepsilon_i^{BS}; \qquad \text{and} \qquad \varepsilon_i^{PP} = \upsilon_i^{PP} + \alpha^{PP} \varepsilon_i^{BS} \tag{9}$$

where the terms $\alpha^{BS}\varepsilon_i^{FS}$, $\alpha^{P}\varepsilon_i^{BS}$ and $\alpha^{PP}\varepsilon_i^{BS}$, result from using $\hat{FS}_i^*$ and $\hat{BS}_i^*$ instead of FS_i^* and BS_i^*, respectively.

Accordingly, the composite error vector $\{\varepsilon_i^{FS}, \varepsilon_i^{BS}, \varepsilon_i^{P}, \varepsilon_i^{PP}\}$ is distributed as multivariate normal with zero mean vector and covariance matrix:

$$\Omega = \begin{bmatrix} \Omega_{11} & \Omega_{12} \\ & \Omega_{22} \end{bmatrix} \tag{10}$$

where Ω_{11} is 3 x 3, Ω_{12} is 3 x 1 and Ω_{22} is 1 x 1, such as:

$$\Omega_{11} = \begin{bmatrix} 1 & \sigma_{FS,BS} + \alpha^{BS} & \alpha^P(\sigma_{FS,BS} + \alpha^{BS}) \\ & 1 + (\alpha^{BS})^2 + 2\alpha^{BS}\sigma_{FS,BS} & \sigma_{BS,P} + \alpha^P\left(1 + \alpha^{BS}\sigma_{FS,BS}\right) + \alpha^{BS}\alpha^P\left(\sigma_{FS,BS} + \alpha^{BS}\right) \\ & & (\alpha^P)^2\left[(\alpha^{BS})^2 + 1 + 2\alpha^{BS}\sigma_{FS,BS}\right] + 1 + 2\alpha^P\sigma_{BS,P} \end{bmatrix}$$

$$\Omega_{22} = \left(\alpha^{PP}\right)^2\left[\left(\alpha^{BS}\right)^2 + 1 + 2\alpha^{BS}\sigma_{FS,BS}\right] + 1 + 2\alpha^{PP}\sigma_{BS,PP}$$

$$\Omega_{12} = \begin{bmatrix} \alpha^{PP}(\sigma_{FS,BS} + \alpha^{BS}) \\ \sigma_{BS,PP} + \alpha^{PP}\left(1 + \alpha^{BS}\sigma_{FS,BS}\right) + \alpha^{BS}\alpha^{PP}\left(\sigma_{FS,BS} + \alpha^{BS}\right) \\ \left(\alpha^{P}\right)\left(\alpha^{PP}\right)\left[\left(\alpha^{BS}\right)^2 + 1 + 2\alpha^{BS}\sigma_{FS,BS}\right] + \alpha^{P}\sigma_{BS,PP} + \alpha^{PP}\sigma_{BS,P} + \sigma_{P,PP} \end{bmatrix}$$

The four equations are jointly estimated by maximum likelihood. To construct the sample likelihood function, we first introduce the conditional and marginal distributions of the error terms. The conditional distribution of $\{\varepsilon_i^{FS}, \varepsilon_i^{BS}, \varepsilon_i^{P} \mid \varepsilon_i^{PP}\}$ is trivariate normal with mean vector and covariance matrix, respectively:

$$\xi_{1.2} = \Omega_{12}\Omega_{22}^{-1}\varepsilon_i^{PP} \qquad \text{where} \quad \varepsilon_i^{PP} = PP_i - \left(\beta^{PP}x_i^{PP} + \alpha^{PP}\hat{BS}_i^{*}\right) \tag{11}$$

$$\Omega_{11.2} = \Omega_{11} - \Omega_{12}\Omega_{22}^{-1}\Omega_{12}^{'} \tag{12}$$

whereas the marginal distribution of $\{\varepsilon_i^{FS}, \varepsilon_i^{BS}, \varepsilon_i^{P}\}$ is trivariate normal with zero mean vector and covariance matrix Ω_{11} (Kotz et al., 2000).

The conditional probabilities for an individual who is willingness to pay a positive amount of money for labelled beef are (for $j = 1,2,3$):

$$\begin{aligned} &\Pr\left(FS_i = j, BS_i = j, P_i = 1 \middle| \varepsilon_i^{PP}\right) = \\ &= \Psi\left[\mu_j^{FS} - \beta^{FS}x_i^{FS} - \xi_{1.2(1)}; \mu_j^{BS} - \beta^{BS}x_i^{BS} - \alpha^{BS}\hat{FS}_i^{*} - \xi_{1.2(2)}; \beta^{P}x_i^{P} + \alpha^{P}\hat{BS}_i^{*} + \xi_{1.2(3)}; \Omega_{11.2}\right] \\ &- \Psi\left[\mu_{j-1}^{FS} - \beta^{FS}x_i^{FS} - \xi_{1.2(1)}; \mu_{j-1}^{BS} - \beta^{BS}x_i^{BS} - \alpha^{BS}\hat{FS}_i^{*} - \xi_{1.2(2)}; \beta^{P}x_i^{P} + \alpha^{P}\hat{BS}_i^{*} + \xi_{1.2(3)}; \Omega_{11.2}\right] \end{aligned} \tag{13}$$

where $\xi_{1.2(j)}$ (j = 1,2,3) are elements of the conditional mean vector $\xi_{1.2}$ defined in (11) and $\Psi[\cdot,\cdot,\cdot;\cdot]$ is the trivariate normal cumulative density function (CDF) with the last element being the covariance matrix.

Likewise, using the marginal distribution of $\{\varepsilon_i^{FS}, \varepsilon_i^{BS}, \varepsilon_i^{P}\}$, the probabilities for a consumer that is not willingness to pay is the following ($j = 1,2,3$):

$$\begin{aligned} &\Pr\left(FS_i = j, BS_i = j, P_i = 0\right) = \\ &= \Psi\left[\mu_j^{FS} - \beta^{FS}x_i^{FS}; \mu_j^{BS} - \beta^{BS}x_i^{BS} - \alpha^{BS}\hat{FS}_i^{*}; -\left(\beta^{P}x_i^{P} + \alpha^{P}\hat{BS}_i^{*}\right); W_i'\Omega_{11}W_i\right] \\ &- \Psi\left[\mu_{j-1}^{FS} - \beta^{FS}x_i^{FS}; \mu_{j-1}^{BS} - \beta^{BS}x_i^{BS} - \alpha^{BS}\hat{FS}_i^{*}; -\left(\beta^{P}x_i^{P} + \alpha^{P}\hat{BS}_i^{*}\right); W_i'\Omega_{11}W_i\right] \end{aligned} \tag{14}$$

where $W_i = \text{diag}\{1,1,-1\}$, which accommodates sign changes in the integration limit and covariance matrix while evaluating the trivariate normal probabilities as lower-tailed CDFs.

Finally, using expressions (13) and (14) and a dichotomous index d_{ij} defined such that $d_{ij}=1$ if $A_i = j$ and zero otherwise, the sample likelihood function adopts the following expression:

$$
\begin{aligned}
L \;=\; & \prod_{FS_i=1,P_i=1} \prod_{j=1}^{3} \left[\Pr\left(FS_i = 1, BS_i = j, P_i = 1 \middle| \varepsilon_i^{PP}\right) \phi\left(\varepsilon_i^{PP}; \sigma_{PP}^2\right)\right]^{d_{ij}} \\
& \text{x} \prod_{FS_i=2,P_i=1} \prod_{j=1}^{3} \left[\Pr\left(FS_i = 2, BS_i = j, P_i = 1 \middle| \varepsilon_i^{PP}\right) \phi\left(\varepsilon_i^{PP}; \sigma_{PP}^2\right)\right]^{d_{ij}} \\
& \text{x} \prod_{FS_i=3,P_i=1} \prod_{j=1}^{3} \left[\Pr\left(FS_i = 3, BS_i = j, P_i = 1 \middle| \varepsilon_i^{PP}\right) \phi\left(\varepsilon_i^{PP}; \sigma_{PP}^2\right)\right]^{d_{ij}} \\
& \text{x} \prod_{FS_i=1,P_i=0} \prod_{j=1}^{3} \left[\Pr\left(FS_i = 1, BS_i = j, P_i = 0\right)\right]^{d_{ij}} \\
& \text{x} \prod_{FS_i=2,P_i=0} \prod_{j=1}^{3} \left[\Pr\left(FS_i = 2, BS_i = j, P_i = 0\right)\right]^{d_{ij}} \\
& \text{x} \prod_{FS_i=3,P_i=0} \prod_{j=1}^{3} \left[\Pr\left(FS_i = 3, BS_i = j, P_i = 0\right)\right]^{d_{ij}}
\end{aligned}
\tag{15}
$$

where $\phi\left(\varepsilon_i^{PP}; \sigma_{PP}^2\right)$ is the univariate normal probability density function of ε_i^{PP} with mean zero and variance σ_{PP}^2.

4. Results

4.1. Data and Variable Definitions

In the paper, the methodology mentioned above has been applied to explain willingness to pay for label-certified beef. As the estimation of the model given by (1), (6), (7) and (8), maximizing expression (15) is rather complex, we have estimated first each equation individually to have an idea of what should be the most relevant explanatory variables that should be included in each equation. The complete list of variables included in the model is shown in Table 4.

The first four variables are the endogenous ones. Mean values indicate that, in general terms, perceived safety for food and beef is medium, but only 27% of respondents are willing to pay a positive amount for labelled beef to increase safety level. As a consequence, increases over the paid price consumers are willingness to pay is only the 5%. As regards the rest of variables (explicative ones), it can be observed that apart from two continuous variables, consumption/per capita/per week and average paid price, the rest of variables are dummies trying to capture whether consumers are influenced by media in their purchases, whether they pay attention to label information, level of education and income, whether they live in the south of Spain and, finally, whether they purchase beef very frequently.

4.2. Estimation results

In Table 5 estimated parameters for the four-equation model are shown. In general terms, signs of parameters are quite consistent with expectations. Among socio-economic characteristics of respondents, only education and income influence some of the equations. More precisely, education is significant explaining consumers' attitudes towards food safety, while income is relevant in the willingness-to-pay equations.

Results from the first equation indicate that consumers, who mainly receive information on food safety through mass media, and those living in the South of Spain, are less confident about such issue. On the contrary, those consumers who regularly pay attention to food labels and feel confident about

the information included have a more positive attitude towards food safety. Education is also important. Higher educated people are more satisfied with the existing food safety standards.

Table 4. Definitions of variables and sample statistics

Variable	DEFINITION AND MEASUREMENT	Mean	Standar Deviation
Attitudes towards food safety (FS)	Respondent's overall satisfaction with food safety (low=1; medium=2; high=3)	1.94	0.78
Perceived safety for beef (BS)	Respondent's overall satisfaction with beef safety (low=1; medium=2; high=3)	1.80	1.43
Willingness to pay (P_i)	Whether an individual is willing to pay for labelled beef (yes=1; no=0)	0.27	0.45
Increase in price individual is willing to pay (PP_i)	Increase over paid price an individual is willing to pay for labelled beef	0.05	0.10
Average price paid for beef, in euros (PRICE)	Continous	9.12	1.35
Percapita consumption per week (Q_i)	Continous	0.25	0.29
Media Influence (MI_i)	Whether an individual is influenced by media in his purchase habits (yes=1; no=0)	0.52	0.50
Respondent's attention paid to labels and confidence on information included in them (INF)	Dummy variable which takes the value 1, if the respondent reads labels often or very often and is confident or very confident with the information included, and 0, otherwise.	0.49	0.50
Medium level of education (ME_i)	Dummy variable which takes the value 1 if the respondent only has secondary school, and 0, otherwise	0.74	0.44
High level of education (HE_i)	Dummy variable which takes the value 1 if the respondent has high school, and 0, otherwise	0.16	0.37
Medium level of income (MI)	Dummy variable which takes the value 1 if the household's income lies between 900 and 2100 € /month, and 0, otherwise	0.79	0.41
High level of income (HI)	Dummy variable which takes the value 1 if the household's income is higher than 2100 € /month, and 0, otherwise	0.02	0.14
Living in the south (SOUTH)	Dummy variable if the respondent lives in the South, and 0, otherwise	0.21	0.41
High frequency of buying beef (HFB)	Dummy variable which takes the value 1 if the respondent buys beef very often, and 0, otherwise	0.24	0.43

As regards consumers' perception of beef safety, a positive and significant relationship has been found between positive attitudes towards food safety and such variable. The two variables related to beef consumption (Frequency of purchasing and per capita consumption level) are also positive associated with positive perceptions about food safety. This is quite consistent with expectations, as experienced consumers feel more confident about beef safety. The second interesting relationship is between prices paid for beef and beef safety perception. This relationship is negative, indicating that, less confident consumers on beef safety decide to buy more expensive cutlets or higher quality beef to guarantee them that the meat they are buying is safe enough.

Finally, results obtained in the last stage of the procedure are also quite interesting. As mentioned before, this stage consists of estimating two equations. In the first one, the probability of willing-to-pay a premium for label-certified beef is analyzed. Three types of explanatory variables are relevant: First, the consumers' perception of beef safety, which, on the other hand, allow us to corroborate the recursive structure of the estimated model. This variable is negatively related to the probability of paying a premium, indicating that as the beef is perceived safer the need to pay a premium diminishes. The second set of variables is related to the level of consumption. In this case more experienced consumers show a higher probability to pay the premium. Finally, as consumers' income increases, they are more likely to pay a premium for certified beef.

Table 5. Maximum-likelihood joint estimation of the four-equation model [a]

VARIABLE	Perceived safety for food (FS_i)	Perceived safety for beef (BS_i)	Willingness to pay (P_i)	Price premium individual is willing to pay (PP_i)
Constant	0.42* (2.80)	0.29 (0.80)	-1.78* (-16.99)	0.45* (9.06)
Media Influence (MI_i)	-0.36* (-3.97)			
Label information (INF_i)	0.25* (2.73)			
Living in the south ($SOUTH_i$)	-0.76* (-6.55)			
Medium level of education (ME_i)	0.29* (1.99)			
High level of education (HE_i)	0.33** (1.83)			
Perceived safety for food (FS_i)		0.88* (6.56)		
Percapita consumption (Q_i)		1.27* (6.32)	1.19* (4.88)	-0.20* (-3.61)
High frequency of buying (HFB_i)		1.54* (11.26)	0.48** (1.91)	-0.13* (-2.54)
Price ($PRICE_i$)		-0.13* (-3.44)		
Perceived safety for beef (BS_i)			-0.51* (-4.34)	0.10* (4.30)
Medium level of income (MI_i)			0.88* (7.20)	-0.06* (-2.29)
High level of income (HI_i)			1.52* (4.12)	0.003 (0.04)
μ_2^{FS}	1.12* (18.73)			
μ_2^{BS}		1.04* (14.18)		
Log-likelihood	-1.94			

[a] One asterisk (*) denotes significance at the 5% level; two asterisks (**) denote significance at the 10% level.

In the second equation, for those who have answered positively to the first equation, main determinants of the exact overprice consumers are willing-to-pay are considered. As mentioned above, the average premium is relatively low (5%). Explanatory variables are the same than in the first equation although some signs have changed, which is not inconsistent. In this case, once consumers have decided to pay a premium, the amount varies inversely with the consumption level. This is not surprising as food expenditure is household food expenditure is constrained. Income level is also associated positively with certified beef overprices. As mentioned in the previous paragraph consumers who perceive beef as safe enough have a lower probability to pay a premium for certified beef. However, among these people, once they have decided to pay, the premium they are willing to pay increases with positive beef perception.

5. Concluding remarks

Increasing consumers' concerns on beef safety has reduced beef consumption in Spain. Reinforced controls have been implemented at all stages of the beef chain and traceabiity and quality labels in order to certify consumers that labeled beef was safe. However such controls have increased, production cost, which ultimately have been transmitted into retail prices. This paper has investigated the consumers' willingness to pay for certify beef.

The main novelty of this paper is that, instead of estimating a single equation willingness-to-pay equation, an attempt has been made to analyse main factors affecting the different steps in the consumers' making decision process. Then, a three equation model (attitudes towards food safety, beef safety perception and willingness-to-pay) has been jointly estimated. A recursive structure has been specified assuming a causal chain along the three equations. Results obtained from this study show that although consumers are increasingly concerned about food safety issues, they are not willing to pay more for labelled beef. In fact, three-out-of-four respondents declare not willing to pay anything. This result, to a certain extent, allow us to assess both the real impact that food scares have had in Spain and the instruments that have been used to recover consumers' confidence in food. Traceability per se is not going to be able to recover beef consumption. Probably, beef price reductions, as those implemented in the UK, are expected to provoke a positive answer in consumers. Spanish consumers perceive food safety as a minimum requisite producers have to guarantee and do not understand why they have to pay a premium for it.

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